THE SANITATION OF BRITISH TROOPS IN INDIA

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OF

BRITISH TROOPS IN INDIA.

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BY

E. CARRICK FREEMAN,

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TO

THE ARMY MEDICAL SCHOOL, NETLEY,

THIS OUTLINE

OF INDIAN MILITARY HYGIENE

IS INSCRIBED.

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THE SANITATION OF BRITISH TROOPS IN INDIA

CHAPTER I.

INTRODUCTORY.

THIS little book is written to be, in the first place, an assistance to the medical officer while making his sanitary inspections, especially if newly arrived in India, and secondly to make, if possible, the sanitary precautions necessary for the preservation of the health of British troops in India intelligible to non-medical readers. The subjects dealt with are therefore taken much as they present themselves when a tour of the barracks is being made; the language used is as untechnical as possible, and authorities are not

quoted. In some respects it is obvious that the military sanitarian is at a great advantage in comparison with his civilian *confrère.* He has under his charge men for the most part healthy, and in the prime of life, whose food, clothing, and exercises are carefully regulated and supervised, and whose dwellings are usually spacious and airy. There is no large native population, with its castes and prejudices to be considered, and there is an organized system of conservancy.

Unfortunately, however, in spite of these advantages, army hygiene has many difficulties and drawbacks of its own to contend with. Military exigencies often require garrisons to be maintained in places notoriously unhealthy, and the duties of soldiers often expose them to insanitary conditions which do not apply to the civilian.

Financial considerations also weigh heavily on military hygienic progress. Barracks once erected are not readily vacated, although it may be impossible to adapt them to modern sanitary requirements, and the sites they occupy are well known to be unhealthy. In

other cases, barracks built merely for temporary purposes are allowed to continue year after year, and are never replaced by permanent buildings. The military mind has, too, a strong and intensely conservative bias, and the fact that any system or arrangement has been in use for a long time is considered a strong argument for its retention, however unfortunate may have been its results. In the same way, modern discoveries in medicine or hygiene are looked at at first with great disfavour, and stand no chance of acceptance until they have been proved up to the hilt in civil practice.

Little weight is attached to anticipations of evil, and only when an epidemic has arrived does the medical officer find himself endowed with full authority, and a free hand to carry out long-needed reforms.

Another and most important consideration is the fact that the military medical officer has advisory functions only, actual sanitation being in the hands of the Royal Engineers and the Quartermaster-General's Department. He has no statutory powers behind him like

the Medical Officer of Health, and it is only by securing the willing co-operation of those in authority, and by educating public opinion, that he can hope to see his sanitary ideas carried out.

It behoves him, therefore, to be most careful in the recommendations he makes, and by no means to let his zeal carry him away into impracticable suggestions, lest he be stigmatized as a mere faddist; and, on the other hand, he should lose no opportunity of indoctrinating those in command with his views, and of explaining to them the reasons on which his recommendations are based.

The principles which underlie the sanitary practice here recommended are those now universally held as true, and which form the foundation of all modern sanitation, namely: That the specific fevers, and especially enteric fever and cholera, are due to the ingestion of certain living germs by people who are susceptible to the disease. That these living germs are derived from people already suffering from the disease, and, in the case of cholera and enteric fever, are

usually conveyed from one person to another in articles of food or drink, especially water, which have been contaminated directly or indirectly by the discharges of someone previously stricken with the same disease, the organism of cholera being known as the *Spirillum choleræ*, or Koch's comma bacillus, and that of enteric fever as Eberth's *Bacillus typhosus*. These minute organisms belong to the vegetable kingdom, as do the organisms of most of the infectious diseases, the principal exception being the amœba of dysentery, which is a low form of the animal kingdom. It is also known that these diseases are always disseminated by pre-existing cases, and never arise *de novo*, although the path of infection is sometimes exceedingly difficult to trace.

It has been lately discovered that Eberth's bacillus can live for long periods outside the body under favourable circumstances, both in the soil and in water; and that, though the cholera microbe perishes quickly when dried, it will live persistently in pure water. These recently ascertained facts will probably ex-

plain many cases in which it has been difficult or impossible to find the source of infection. The life-history of the malarial parasite has not yet been completely worked out, but if Manson's mosquito theory be correct, ague will also take its place as being in part a water-borne disease.

Cholera and enteric fever, being due to distinct specific causes, ought to be capable of steady diminution by sustained sanitary effort. This is already true in the case of cholera. Enteric fever (the disease *par excellence* of civilization) has, on the other hand, increased of late years owing to the influx of young and therefore specially susceptible soldiers into India, the great vitality of the bacillus, and the erroneous ideas until lately held as to the nature of the infection.

Malaria, being endemic, can never be entirely got rid of, although the severity of its attacks may doubtless be much lessened by proper sanitary precautions.

There are many other infective diseases due to microbe organisms. Some, like diphtheria and whooping-cough, do not appear

to flourish in India. Others, like scarlet fever and measles, when met with, are well known to be contagious, and are treated on the same principles of isolation and quarantine as in England.

Modern sanitary engineering, while it has effected vast improvements, has, by concentrating water-supplies, also rendered possible great catastrophes, like the recent epidemic of enteric fever at Maidstone. The knowledge of such possibilities should warn us to look beyond the walls of our barracks, and to keep a watchful eye on the water-supply and conservancy of the whole cantonment and neighbourhood.

CHAPTER II.

GENERAL CONSIDERATIONS.

BEFORE proceeding to a consideration of details, there are certain leading points in Indian hygiene which require special notice.

India is so vast a country, presents such varied geographical conditions, and is inhabited by such numerous races, that, although the principles of hygiene remain the same always, much experience is required for their successful application in detail.

Owing to the primitive habits of the natives, the face of the country, wherever the population is at all dense, may be regarded as little better than one huge latrine. The purifying and germicidal agencies which tend to counteract the evils of this state of affairs are the intense heat and light of the

sun, the extreme dryness of the air in many parts, and the length, volume, and rapid flow of the great rivers. Other refuse is accounted for by Nature's scavengers—the vulture, the dog, the jackal, and numerous hordes of insects; while the pungent smoke of the wood-fires and the aromatic condiments indulged in by the native are of value as antiseptics.

The seasonal prevalence of disease is well marked. In the hottest months (April, May, and June) the burning rays of the sun form an effectual germicide, and cases of enteric fever or cholera very seldom occur. In July the rains break, and sweep all the accumulated surface dirt into the water-courses, while the steamy moisture which arises forms an ideal atmosphere for the development of germs of all sorts. This is the season for cholera epidemics. Later on the troops returning from the hill stations usually bring enteric fever down with them to the plains, where it flourishes throughout the cold weather, diminishing as the temperature rises in March and April.

Ague is little prevalent during the hot weather, but breaks out directly after the rains with a severity which varies in accordance with the amount of the rainfall.

Failure of the rains means famine to the native, but brings a healthy autumn and cold season to the European soldier.

The plague, too, in places where it is endemic, abates its virulence in the hot weather, increasing again as the temperature falls.

In the Punjaub and Northern India, where the winter is cold, chest affections of all kinds become common among British troops, specially those who have acquired a malarial taint, and infective pneumonia is very rife at that time among the Sepoys on account of the small, unventilated, ill-built huts they inhabit.

Heat apoplexy and sunstroke occur usually towards the end of the hot weather, although the mid-day sun is strong enough in most places to cause severe headache, if not sunstroke, all the year round.

There is usually a marked diminution of

specific contagious disease among the troops remaining in the plains during the hot weather, which is, however, more than counterbalanced by the cases among the men who are stationed in the hills.

The incidence of disease is different in different races. Enteric fever is rare among the natives, but occurs, unfortunately, in an ever-increasing ratio among the British troops. Cholera, on the other hand, is far commoner among the native population. Hence, in any outbreak of enteric fever we may be pretty sure that the ultimate source of infection will be traceable to the barrack or the hospital, while cholera is equally certain to have been imported from the bazaar or other native sources outside the lines.

The bubonic plague attacks the Hindoos principally, and especially certain castes of them, particularly the Jains. Mohammedans and Parsees suffer much less, and Europeans are rarely attacked.

Malaria and dysentery affect the native almost as much as the European.

Vaccination, rigidly enforced among the

troops, protects them from small-pox, which is common and virulent with the natives, among whom vaccination is permissive, and not compulsory.

Hydrophobia is more frequent than in England, Europeans being nearly always the sufferers.

Finally, there are many tropical diseases which are rife among the natives in various parts of India, such as leprosy, beri-beri, and elephantiasis, which never affect the European soldier. The same may be said of calculus and cataract.

The geographical distribution of diseases is a large subject, and can only be lightly touched on here, although of great hygienic importance. Enteric fever appears wherever the British soldier is present. Cholera, while widely diffused, has its strongholds in Bengal and the North-West Provinces. Dysentery occurs chiefly in Burmah and Southern India, while in the hill stations we find the peculiar affection known as hill diarrhœa. Malaria, in all its forms, is of very wide distribution, occurring both near rivers and canals, and

also where the soil is dry and porous, as at Quetta (in spite of an elevation of over 5,000 feet). In Northern India and the Punjaub it is not uncommon to meet with cases of fever resembling to some degree both enteric and ague, which do not improve under quinine, and yet present no symptoms of abdominal disturbance. It has lately been demonstrated that these cases are identical with the so-called Malta and Mediterranean fever, and are due to the *Micrococcus Melitensis* of Surgeon-Major Bruce. Little is known at present of the life-history of this organism, formerly supposed to be confined to Gibraltar and Malta, but there is no doubt that it is a filth disease, and that the precautions taken against enteric fever are also effective against this micrococcus. Tubercle in all its forms, scarlet fever, diphtheria, and typhus fever, are very rare in India, though an outbreak of the latter occurred a few years ago among the men working at the Khojak Tunnel.

Finally, it should be noted that the more recent a soldier's arrival in India, the more

susceptible he is to enteric, and in a lesser degree to cholera and dysentery.

Liver abscess occurs usually in the old stager, as does also heatstroke or heat exhaustion, a man's power of resistance to heat, apparently, in many cases, diminishing with successive hot weathers.

Although exceptions are occasionally met with, still, it may be safely asserted as a general rule that Europeans, after some years' continuous residence in a hot country, degenerate, losing energy, initiative, and memory, to an extent which, from a military point of view, is not compensated for by diminished liability to disease. If, therefore, a long-service army were to be established in India, a system of furlough, whereby the men could return to England at stated intervals, would be a vital necessity.

CHAPTER III.

CONSERVANCY.

I. Pathogenic germs are present in the excreta of all cases of enteric fever and cholera, and probably dysentery.

II. Unless destroyed by suitable disinfectants at the outset, these germs are apt to be spread abroad by various agencies, ultimately getting into food or water, and causing fresh cases of disease.

III. Burial in the ground does not destroy the enteric bacillus, especially if the soil is already polluted with organic matter.

IV. Both enteric and cholera germs can live and multiply in water under favourable conditions.

Now that hygiene is established on the firm basis of bacteriology, it is possible to lay down far more definite sanitary rules and precautions than could be done before, when

our predecessors were struggling against contagions of unknown nature arising from unknown sources.

From the considerations set forth at the head of this chapter, it will be evident that the disposal of sewage must be regarded as a factor of primary importance in securing the healthiness of any locality. It seems, therefore, logical to treat of it in the first place, before proceeding to discuss other matters which are all more or less dependent thereon.

With the exception of the Presidency towns, the universal method of sewerage in India is one of a dry-earth system and hand-carriage, and there can be no doubt that, owing to the cheapness of labour and the scarcity of water, it is on the whole the most convenient and suitable system for the country.

The subject divides itself into the consideration of the immediate and the ultimate disposal of the excreta. The mehters, or sweepers, as the special pariah caste are called who attend to this work, carry out their duties fairly well, if adequately super-

vised, but they are often overworked and badly paid, and then naturally neglect their duties. As might be expected, they are more or less dirty in their attire, even though clean in their persons. Besides their latrine work, they clean and sweep throughout the lines or barracks, and as their brooms and clothing are often soiled with specific discharges, they carry the choleraic or enteric microbes with them. It is therefore a point of the utmost importance to confine the latrine sweeper and his broom strictly to the latrine.

Nothing seems more right and suitable to the native mind (as Professor Hankin has pointed out) than that the same man and the same broom should attend to the, as they think, equally dirty jobs of the cookhouse and the latrine. Nothing is commoner than for this actually to happen, not only in the soldiers' cookhouse, but also in the kitchens of the officers' mess and of the private bungalow. The pathogenic germs are deposited and thrive in the warmth and moisture of the kitchen, and to this cause

alone many outbreaks of disease may be traced.

The sweeper is often brought into the barrack-room to sweep and clean, and even if he uses a different broom, his clothes may be soiled, and may very likely bring infection with them.

The latrine sweeper should be provided with a distinctive dress, in place of the old soldier's coat he is always attired in at present. Latrine brooms should also always be dyed a distinctive colour, and neither man nor broom should be allowed to stray from the proper sphere. Long-handled brooms should be served out for the use of the soldiers, who could then very well clean out their own barrack-rooms themselves.

Ladies who employ 'sweeper' ayahs, besides acting in a manner most repugnant to all native ideas of cleanliness, run a very distinct risk of having disease germs imported into their rooms. For the same reason a good 'bearer' will never permit the sweeper to touch the washstand or bath in his master's dressing-room.

It is now established that the comma bacillus is present very early in the disease in the evacuations of cholera patients, and persists until convalescence is well advanced. In enteric fever the bacillus does not appear so early, but persists very late, even up to the forty-first day of convalescence (Lazarus). The bacillus is also present in the urine. Hence, there is always a possibility of specific microbes being present in the sewage of the barracks, derived either from men in the early 'diarrhœa stage' of cholera, or suffering from the 'ambulant' form of enteric fever, or else from convalescents from the latter disease who have returned to duty. The barrack sewage must therefore be always considered as highly dangerous material, and every effort must be made to limit its diffusion as far as possible. For this purpose the whole latrine system must be carefully supervised, attention being specially directed to the following points:

1. The accommodation provided must be sufficient, the scale laid in the regulations being taken as the minimum.

2. Latrines must be conveniently situated, or men will always overcrowd a small one, and neglect a larger one, if it happens to be a little further off.

3. The roof of the building must be water-tight, the floor of hard, dry earth (until a more impermeable material is allowed), and the walls must be frequently lime-washed.

4. The earthenware latrine pans must be kept clean, and should be renewed as soon as the surface glaze is destroyed, otherwise, when the surface is roughened, they must harbour germs and become septic. Colonel Quill, R.A.M.C., advocates the substitution of enamelled iron pans, or, failing this, that a double set of earthenware pans should be kept in use, each set in turn being disinfected and exposed to the sun. The idea is a good one, as it would tend to limit the period of possible infectivity of any one utensil.

5. The sweepers must be sufficiently numerous to promptly empty and cleanse the latrine pans, otherwise nuisance is inevitable.

6. Chloride of lime or other disinfectant must be freely used, not as a substitute for

cleanliness, but in order to drive away the flies, which otherwise collect and become active agents in disseminating disease.

7. A good supply of dry earth must be maintained, and the soldiers educated into using it. It would be a great advantage if some automatic form of Moule's earth-closet could be brought into use. It could be worked much more easily than in England.

8. The receptacles into which the pans are emptied must have well-fitting lids, must not leak, and must be frequently tarred.

9. As the enteric bacillus can live in earth for considerable periods, it is never safe to take up and remove the earthen floor of the latrine. Fresh earth mixed with lime may be laid on the surface from time to time and rammed hard.

10. Responsible supervision by a European N.C.O. is essential.

So far we have spoken of the soldiers' latrines. Others are provided within the lines for the native followers, lascars, etc. These are very inferior in construction and in accommodation, are undermanned with

sweepers, and are always a source of anxiety and danger. Until they are provided and equipped on a more generous scale, little can be done beyond seeing that they are kept as clean as circumstances permit, and that they are not placed in any situation where they are likely to spread infection, as in the neighbourhood of barrack-rooms, kitchens, or wells. They are apt to be placed near the latter for purposes of ablution. It is also necessary to ascertain that sufficient accommodation is provided for native women and children.

The greatest safeguard against the spread of preventible disease would be found if all fæcal matter could be mixed with some sterilizing substance, so as to destroy any pathogenic organisms present before removal from the latrine. Doubtless some such material will be discovered. At present we can only say that corrosive sublimate is too poisonous, mineral acids are too dangerous, and that the other disinfectants are too expensive and too bulky. A German writer, however, has lately stated in the *British Medical Journal* that quicklime mixed in the proportion of 4 per

cent. with dry earth is an effective germicide, and retains its powers for a long time. If this is really the case, it will afford a good and cheap material for the purpose. The objection to quicklime heretofore has been that it soon becomes moist and useless; mixture with earth would doubtless tend to correct this, but it is to be feared that during the rains, at any rate, it would prove inefficient.

The reasons that render the barrack sewage a probable source of infection apply with tenfold strength to the hospital, and there can be no doubt whatever that the whole of the sewage of every hospital ought to be systematically cremated on the spot. The dejecta of cholera and enteric cases should certainly be burnt, but when this cannot be done, they must be treated with a strong antiseptic solution; but it requires care to get the hospital attendants to use sufficient disinfectant, and to leave it sufficiently long in contact with the discharges. Hankin recommends sulphuric acid or sulphate of copper solution for the purpose, and deprecates

burning, because it entails removal and manipulation of the dejecta. Drs. Hill and Abram have made investigations (*British Medical Journal*, April 15, 1898), and have found that any of the following substances will sterilize a typhoid stool :

Carbolic acid, one part in twenty.

Crude carbolic acid, formol, or creolin, one part in forty.

Perchloride of mercury, one part in five hundred.

Chinosol, one part in six hundred.

Of these, chinosol is stated to be far the most convenient, crude carbolic acid the cheapest, corrosive sublimate is too poisonous, and formol and creolin are both expensive. Chloride of zinc, sulphate of copper, chloride of lime, and boiling water in these experiments all proved quite unreliable.

We have now to consider the ultimate disposal of the sewage, which is removed from the latrines at stated times by conservancy carts made of galvanized iron, usually drawn by one or two bullocks. These carts often leak, and seldom have

perly-fitting lids. They leave a trail of gusting odour behind them as they journey rough the cantonment, and may be con-dered fairly active agents in the spread of isease, especially during the rains. A certain mount of nuisance is inseparable from this arrangement, which can be minimized by having the carts kept in good repair and frequently tarred and disinfected. The bullocks employed should be efficient, not old animals past work. These matters are, however, usually in charge of the Cantonment Magistrate. The destination of these carts is the sewage ground, where they are emptied into shallow trenches, which are then filled in with earth. After the ground has been in use for two months, it is ploughed up and planted with rye-grass.

Theoretically this system is good, but in practice the trenches are dug much too deep, and too much sewage is put in them. The after-cultivation is also very insufficient. Moreover, there is never any proper European supervision. A sewage farm upon the European model would be impossible in

India, on account of the scarcity of wa[illegible] the small size of the Indian ploughs, and [illegible] suspension of cultivation during the [illegible] weather.

To ensure the proper working of the India[illegible] system, attention should be directed to th[illegible] following points:

1. The ground selected must be remote[illegible] from the water-supply, and some distance from a cantonment. It must not be liable to be flooded during the rains.

2. It must be approached by a good road, a precaution which is very generally neglected, with the result that in wet weather the tracks become impassable, and the carts never reach their destination, but break down *en route*, their contents being often deposited in the nearest ditch.

3. Fresh ground must be frequently taken into use, and the old ground kept under cultivation for long periods before being again utilized.

4. The sewage must be buried as near as possible to the surface of the soil, and spread over the largest possible area, in order to

ain the maximum nitrifying effect from bacteria of the soil.

5. European supervision is a *sine quâ non*. Recent researches, however, have demonstrated that the whole system of burying sewage is open to grave suspicion. Drs. Martin and Robertson, in England, have shown that the *Bacillus typhosus* has a most surprising vitality in earth, and especially in earth saturated with organic matter, living twenty-three days in virgin soil, but 220 days in contaminated soil. It is probable that these periods may be much modified by the great heat of India, and also by the moisture or dryness of the atmosphere. On all these points experimental research is urgently required.

This vitality of the enteric germ in the soil is probably one cause, at any rate, why the disease appears to be endemic in certain stations; and therefore in all such places some other method of sewage disposal should, if possible, be employed. The practice of disposing of the sewage to the cultivators for manure, which prevails at some stations

—as, for example, at Poona—obviously of great facilities for the spread of disease, must be unhesitatingly condemned.

In all hill stations, in all places where the ground is hard rock, and in all stations where the sewage-farm system cannot be conveniently and safely used, incinerators should be installed, and the whole of the sewage burnt. This is really the only safe and satisfactory method of sewage disposal, all germs being destroyed with certainty and despatch. Several forms of apparatus have been designed for the purpose, and now that 'refuse destructors' have come into such general use in England, there should be no difficulty in procuring a very perfect type. It is doubtful whether, when once fairly started, the cost of incineration would much exceed that of the present unsatisfactory arrangements. The furnaces would be kept alight chiefly by dry rubbish, and the ashes would command a good price as manure, for which purpose they could be safely used. Even if the expense were somewhat greater, the Government would quickly be recouped

he diminished sickness and mortality in station.

The special points requiring attention in e use of an incinerator are :

1. To select a position sufficiently removed prevent the smoke becoming a nuisance ; properly constructed apparatus should give ut no smell at all.

2. Having selected a good pattern of apparatus, to see that it is properly and substantially erected. More than one incinerator has been a failure from lack of attention to this point.

3. All fæcal matter must be placed in the incinerator, and deposited nowhere else, and the whole of it completely reduced to ashes before removal. It can then be safely used as manure.

4. As much as possible of the offal and rubbish which is now wasted must be collected, dried, and used as fuel.

5. European supervision is absolutely necessary to ensure all this being properly carried out.

In hill stations the sewage has usually

been simply emptied down the ravi with the result that enteric fever is pra cally endemic in all of them. If th places are still to be considered as sa taria and not as pest-houses for the soldie they must be equipped with incinerator otherwise excreta will still infect the water supplies, and the vicious circle of disease will continue. In many of these stations disease has now become so ingrained that they should be abandoned for a couple of years.

Another system is in vogue at Murree, where the sewage is placed in receptacles, which travel along an overhead wire rope to points far away in the valleys below. This arrangement cannot be considered scientific, as the ultimate infection of the water-supply, either directly or indirectly, is still probable.

Finally, another system of sewage disposal, which is still in its infancy, may be briefly mentioned. This is what is known as the Septic Tank System; and it has been tried with good results at Exeter. It will probably be shortly tested at Colombo, and the result

be awaited with great interest. In this hod the sewage is collected in specially-structed tanks, and is broken up and ified by the action of the bacteria which itself produces into elementary and harm-ss constituents. If found inapplicable to rdinary cantonments, this system might, erhaps, replace the sewers of Bombay and Calcutta, which are certainly unsuitable for hot climates. If, however, this system answers expectations, it should be applicable almost everywhere, and as it depends on the action of purely natural forces, its working, when once installed, is almost automatic, only the minimum amount of supervision being required.

CHAPTER IV.

WATER.

I. Microbes adhere to, grow on, and may be transported by, moist surfaces.

II. Eberth's bacillus will live for short periods, and the comma spirillum for long periods, in water, especially if other bacteria are not present.

III. Both are destroyed immediately by boiling water, and less quickly by the addition of certain chemicals.

IV. Wells are likely to be infected from the surface, as filtration through the soil is usually sufficient to destroy microbes.

V. Large volumes of water exposed to the action of light and heat are self-purifying.

THE importance of this subject may be estimated when we consider that the two principal diseases of India — cholera and enteric fever—are usually 'water-borne,' and

owing to the climate, the soldier there much more water than in England. regular system of waterworks, and distion of drinking-water by pipes, has been instituted in many Indian cantonits. Some, however, owing to situation other causes, are incapable of being so pplied, and in these recourse must still be d to springs, wells, and rain-water tanks.

The water-engineer has special difficulties to contend with in India. During the rains the flooded rivers threaten to overwhelm the works on their banks; in the hot weather rivers, springs, and wells tend to dry up, so that when water is most needed it is least available. In consequence, the supply may have to become intermittent, with the risk of contamination to the pipes by suction; or else doubtful springs may have to be tapped to tide over the difficulty, and thus contamination may occur at the source. In the rains the storm-water may invade and destroy the filter-beds.

The municipal filter-beds are usually reliable, but care is required both that the

sand used be free from pathogenic g
and also that no infection occurs after
It must be borne in mind that the fore
of an Indian river is used by the native
only for bathing, ablution, and defæca
but also as a place of cremation for the d
and of lustration for the dying. The wh
area occupied by the waterworks must
most jealously isolated and guarded fro
intrusion, and all labourers employed mus
be kept under strict sanitary surveillance.
Infection of pipe-water may also occur at
the standpipe from infected waterskins, the
bacteria spreading up the moist interior
of the pipe. This is said to have happened
recently at Quetta.

Thus, it is evident that the existence of a
pipe-water supply in any station must not
be considered an absolute guarantee of the
purity of the water, although it enormously
diminishes the risk of contamination. It i
therefore most desirable that such wate
supplies should be tested bacteriologically a
frequent intervals to ensure the early recog
nition of infection, should it occur.

may now proceed to consider the ry method of water distribution in , which is by water-carriers, or bhistis, are a special caste of men, usually hammedans, whose entire occupation it o convey and supply water for drinking d all other purposes. They are, as a rule, nest, conscientious folk, and on service ry brave and enduring. There are two inds—the bhistis who carry water in a eathern mussack slung across the back, and the pukkal bhistis who have bullocks to carry the water in large leathern skins called pukkals.

Mussacks are very apt to carry infection for many reasons. New mussacks give an unpleasant taste to the water, so the old ones are retained as long as possible. The natives think that any running water is wholesome, and the bhisti will often fill his mussack from a roadside stream or ditch in preference to using the standpipe, particularly if the water from the latter is hard or heated from the sun. Moreover, if sent to water roads or gardens, he will be told to

use water from some tank or irri
channel which may easily have been
Needless to say, a mussack once infect
likely to continue so; the interior canno
got at, and the moist, slimy walls afford
admirable nidus for all kinds of organis
which may be imparted to the water pla
in it for an indefinite period of tim
Besides this, Professor Hankin has show
that germs lodged upon the clothing of th
bhisti can attach themselves to the mussack
and grow through into its interior. The
clothing of the bhisti is likely to become
infected, as he is always called in to assist
the sweeper in the removal of the dejecta o
men taken suddenly ill in barracks or i
the hospital ward, and he is pretty sure to
get his clothes splashed in the process.
Hence the bhisti and his mussack are
always to be regarded as probable agents
in the spread of disease.

Heretofore, even when water is laid on i
pipes to the lines, it has been the custom
for the bhistis to draw the water from the
standpipes and distribute it in their mus

thus at once opening up a possible
f infection. It is therefore of the first
tance that the water-pipes should be
on directly into the cook-houses and
ack-room verandas, so as to enable the
iers to get their water straight from the
without its first passing through the
isti's mussack. It has been objected by
e military authorities that such an arrange-
ent would lead to great waste of water,
ut that is a mere matter of discipline. A
nore serious objection is that it would take
way the occupation of the regimental
histis; but work could always be found
or these men in watering gardens, etc., and
ailing that it would still be cheaper to keep
hem in idleness than to risk an outbreak
f enteric amongst the troops. Water laid
n to the kitchens would enable the gal-
anized iron cisterns now in use to be
bolished. These cisterns are expensive,
nd also dangerous, as they are very easily
ouled. Water laid on to the barrack-room
would allow the abolition of surhaies, which
re porous earthen jars kept full of water

by the side of the soldier's bed. The
frequent sources of infection, as the sw
brushes them over with his broom,
germs adhere to the moist surface of
bottle, and readily penetrate through
porous earthenware to the water with
Hankin has several times demonstrat
pathogenic germs in the water of the
surhaies, when the water-supply itself ha
been free from contamination.

When the water-supply is derived fro
wells, bhistis are, of course, a necessity; bu
then (as has already been done in some places)
galvanized iron pails should be substituted fo
mussacks, and iron water-carts used instead
of pukkals, and the risk of infection thus
minimized.

Whenever mussacks are in use, they should
be carefully inspected week by week, and at
regular intervals disinfected with permanganate of potash solution. This must be
done by the bhistis themselves, as they object
to any other person handling their mussacks.

It must be remembered that, when once a
well is infected either by enteric or cholera

it may remain dangerous for an almost ited time. Hankin has found cholera li alive in a well even a year after the ary infection. Contamination of wells is ly due to filth falling or being washed the well-mouth; to an infected lotah ng lowered into the well; or to the infec- n of the well-rope or bucket from the hands the person drawing the water. Again, if e well is not solidly built and well steined, ul water may leak through the sides close the surface of the ground, and in this way rface drainage, water used for ablution, or r washing clothes, may find its way into e well. Water percolating in at low levels less important, as it will have been purified uring its passage through the soil.

Hence, before any well is taken into use y troops, we must ascertain:

1. That the well-mouth is properly pro- ected, and raised above the level of the soil y a masonry platform.

2. That the walls are well and solidly uilt, and in good repair.

3. That the situation is remote from any

source of contamination, such as tank
rines, kitchens, hospitals, and native dwe

Such a well should be set apart for the
clusive use of the troops. No unautho
person should be allowed to approach it,
water should only be drawn from it by
regimental bhisti, who should be strictly
bidden to procure it from any other sour
In many wells the water is drawn up
bullocks, but this should never be used f
drinking purposes, as the bullocks are likel
to contaminate it.

If the water is derived from tanks
reservoirs, the same principles hold good, a
no trouble or expense should be spared
isolating and protecting all such structures
otherwise, the whole body of water stored
likely to become infected.

In cases where wells exist, but are in a
unsatisfactory condition, supplies of pur
water could probably be easily obtained b
using the Norton Tube Wells, which can b
driven to a considerable depth below th
surface, and it is difficult to see how wate
thus obtained could be infected.

e water-supply available is suspected,
s of water-borne disease are occurring
the troops, or if an epidemic has set
is approaching, several courses of action
pen to us.

he drinking water can be impregnated
permanganate of potash sufficiently
ng to give a distinctly pink permanent
ration. The drawback to this is the
y astringent taste it gives to the water,
ich the soldiers object to; and if the per-
ganate is used strong enough to be an
ctual germicide, the water is rendered
lly undrinkable. Used for the purification
infected wells by Professor Hankin, it has
w been demonstrated that permanganate
potash will effectually check cholera. For
s purpose sufficient should be thrown in to
e the water a pink tint for twenty-four
urs. In all epidemics it is most desirable,
fore resorting to other measures, to dis-
ect at the outset all mussacks, cisterns,
chen utensils, water-bottles, etc., with
ong permanganate solution.

The next precaution to take is to boil all

drinking-water, and all the water u
the kitchens; and this effectually do
render any water perfectly safe. A
boiling for two minutes is sufficient t
stroy any microbes present. If, how
this is undertaken, most careful supervi
by the N.C.O.'s will be required to see t
the water *is* actually boiled, and also t
no unboiled water finds its way amon
the troops. If there is any failure
execution, and the outbreak continues,
troops will be disheartened, and a relia
means of protection discredited. For t
same reason, when recommending th
measure to the authorities, stress must
laid on the long incubation period of ente
fever, so that immediate cessation of th
disease may not be expected. In cholera,
course, a more rapid amelioration may
predicted. A variation of the same princi
is to make the men drink tea instead
water, but then, of course, the water us
for cooking or cleaning purposes must still
boiled.

This system of boiling the water is muc

ted by the use of the Larrymore boiler, has already been introduced in certain stations. In any case, water must s be carefully aerated after boiling, or oldiers will not use it. If these pre- ons are rigidly observed, boiling the r will be found to afford an absolutely ble protection.

ur third method of defence (placed last use it cannot be improvised) lies in tion of the water, and for this purpose lters, large or small, fixed or movable, pt the germ-proof Pasteur-Chamber-land, Berkefeld, are absolutely and entirely ss. In fact, all other filters are worse useless, as they introduce fresh sources ntamination to possibly pure water. recent severe outbreak of cholera at know, which was traced to a Macnamara r, may be quoted as a case in point. germ-proof filters are now available, nged in 'batteries,' so that they can give fficiently large and rapid supply of water military purposes. When in use they uire periodical cleansing to prevent their

becoming blocked, and they must be
sionally examined for leakage, which
permit the free passage of germs, and
the filter useless until the faulty 'cand
removed. These filters have been tried
great success in the French army, and al
our own at Allahabad. It is to be h
that their introduction into all messes
barracks will soon be accomplished, as
their means water both pure and palata
can be easily and conveniently supplie
the troops.

When during a march soldiers have f
their water-bottles from doubtful sou
they should be emptied immediately o
turn to barracks, and then filled with
permanganate solution, which should be
in them for twenty-four hours.

The poison of malaria is considered
some authorities to be conveyed by drink
water, and cases of outbreaks of fever t
caused on board ship are recorded.
evidence, however, is far from conclusive, a
ordinary experience of ague lends no supp
to the theory. Still, swamp-water, or wa

ng much vegetable débris, if it has to l, should certainly be boiled as a ionary measure. Dysentery is also o arise sometimes in this way, chiefly rmah and the more tropical parts of . Much of the water in Baluchistan similar places is so impregnated with as to give rise to severe diarrhœa.

he natives of India lay great stress n good water, judging it by its softness, sant taste, and coolness. They talk of g for 'change of water' just as we talk going for 'change of air.' Hankin has wn that they are to some extent right in r ideas, as a salt-tasting water containing rides and nitrates favours the growth of era germs, and is therefore always to be ed on with suspicion.

acteria will survive freezing, so the rce and quality of the ice supplied to pital and barrack must be carefully ex- ned, and it must be wrapped in clean nkets, and not in filthy rags, otherwise hospital ice-box is likely to become a eding-place for germs.

To sum up, in fighting an epide sanitary measures must be well thou and consistently applied, if they ar successful. It is useless to boil the if it is afterwards distributed in in mussacks or other vessels. The whole c cisterns, mussacks, pukkals and pails mu simultaneously emptied, disinfected, and filled with boiled, or otherwise puri water. Any admixture of infected with water, or any contact of pure water wit infected receptacle, is sufficient to nullify whole process, for both the enteric baci and the cholera spirillum will thrive multiply in pure water for long period time.

Mr. Ghadialli, Professor Hankin's assis claims to have discovered a microc which has an inhibitive influence on enteric bacillus. Further experiment however, required in the matter, althoug is stated to have given good results Lucknow when introduced into an infe well.

The question of the 'mineral w

naturally presents itself here. Such
itution exists in every barrack, and
er carried on regimentally by soldiers
have been instructed in the work, or is
t to a native contractor. In either case
nes under the immediate supervision of
Medical Officer. The building set apart
he factory must be suitable for the pur-
e, distant from all latrines and cook-
ses, must be kept scrupulously clean, and
rubbish whatever allowed to accumulate
it. The water, if at all doubtful, should
boiled, and cloths used for straining it
st be changed daily and boiled. Hankin
s that mineral waters which have been
tled for twenty-four hours are quite safe,
g to the germicidal action of the carbonic
on all microbes; arrangements should
efore be made to keep a sufficient supply
and to allow of all bottles being stored
twenty-four hours before being sold.
e is required that pure water be used for
ning the empty bottles, and that all
s, etc., be kept in proper order. The
tles are cleaned either with shot or by

immersion in dilute sulphuric acid. The former plan is bad, the latter good, as it destroys germs.

As the carbonic acid in the soda-water is an active germicide, no soda should on account be added, because, by neutralising the acid, it diminishes its germicidal power. Professor Hankin also advises the addition of ten drops of dilute sulphuric acid to each bottle of mineral water, if any epidemic be prevalent, both as a prophylactic against cholera and to increase the microbe-destroying power of the carbonic acid.

Mineral waters being thus a safe beverage, their use should be encouraged among soldiers as much as possible, and they should be sold at, or below, cost price, even if the canteen funds suffer in consequence.

CHAPTER V.

FOOD.

Warmth, dirt, and moisture form an excellent breeding-ground for all microbes.
Cholera germs may be communicated to the cook-house by the native cooks, and enteric germs by the sweepers.
Flies often act as carriers of microbes.
Food may be infected by utensils washed in impure water, or contact with infected rags.

ideal condition of a barrack in India as ds food-supplies would be one of perma- quarantine, the actual rations being ned from the Commissariat Department, all else produced or grown on the spot. supplies and rations issued to the troops usually of good quality. They are in- ed, and are liable to rejection in the way. It occasionally happens that,

owing to the exigencies of the climate or other causes, the supply of fresh vegetables and meat becomes insufficient, and tinned provisions are issued. Under such conditions a sharp look-out must be kept for scorbutic symptoms, which are apt to appear very suddenly in men with a malarial taint, causing great debility and prostration. In Qu
at one time, nearly all cases admitte
hospital used to be given lime-juice
routine measure, with good results. W
ever lime-juice is issued as a prophyl
fresh limes if possible should be obta
as the preserved juice, though cheap
much less protective against scurvy.

The tinned meat issued to the tro
very good, although unpopular among
men. They will not, as a rule, eat t
or compressed vegetables of any kind.

Tinned articles of food, such as sal
lobster, whitebait, and various fruits,
used extensively throughout India bot
soldiers and civilians. Cases of poiso
often occur, especially in summer.
poisoning seems to be due to some ptom

developed in the tins before any obvious decomposition has occurred. The symptoms include violent diarrhœa and vomiting, and often severe cramps. They closely simulate cholera, to which disease such attacks are often wrongly attributed. All such provisions should therefore be carefully inspected in the regimental 'coffee-shop,' and all tins in the least bulged or giving any peculiarity of sound when shaken should be at once condemned and destroyed on the spot. It is important that all these things should be purchased only from reputable firms, and no old stores bought up in the bazaar on account of cheapness.

Pork and bacon should be sold to the men by licensed hawkers or dealers only. It should all be carefully inspected before being sold, and sausages, etc., should be entirely prohibited during the hot weather and the rains.

At some stations fish is available, and is very popular, but there is always some period during the year (varying in different places) when it becomes unwholesome, and its sale should be discontinued.

Curry, on account of the aromatic and antiseptic substances it contains, is a most wholesome article of diet, and its use should be encouraged as much as possible. Some people even think that there is some connection between the comparative disuse of curry by Europeans in India and the increase of enteric fever.

Melons and pumpkins, especially water-melons, are credited with sometimes producing disease, as they are grown by the natives in pits and freely manured with what is practically raw sewage. Melons are also sold in the bazaar, cut in large slices, which present an excellent nidus for the growth of germs. If, therefore, epidemic disease be at all prevalent, they should be prohibited. Water-cress is also dangerous, being often grown in polluted water. Other vegetables, which are boiled before being eaten, are safe. Lettuces and radishes, if much handled by natives, might possibly be dangerous. Fruit is always prohibited when cholera is about as being a possible cause of diarrhœa.

The barrack cook-houses are often fertile sources of disease. They are always detached buildings, usually one for each company or squadron, and in them the food is prepared by natives using fireplaces of unburnt clay, and copper cooking-pots called degshies. This system is not a good one, and tentative efforts are being made here and there to improve it. It would be much better to employ soldier-cooks, and give them proper cooking-ranges or stoves. Tradition is, of course, against this arrangement, but it has been clearly demonstrated that soldiers when usefully employed keep in better health than when comparatively idle. In most stations it would be impossible for Europeans to do the work in hot weather, but it would be easy to entertain native cooks especially for that period when a large proportion of the troops are gone to the hills. The men themselves are said to prefer the present arrangement, as they get greater variety in the cooking, but it would be easy to teach soldier-cooks to make curries, etc., in addition to the regulation roasts and stews.

These improvements are not likely to become general for some time, so we may take the requirements of an ordinary barrack cook-house such as is found all over India as the minimum standard to which all kitchens should be brought until English cooking utensils, patent ranges and the like can be obtained.

1. The building must be of sufficient size, properly ventilated, and watertight.

2. The ground around it must be level and open, and no well or latrine should be near.

3. The interior must be frequently white-washed.

4. The windows and all apertures must be protected by unbroken wire gauze or perforated zinc, and the door by a blind ('chick') to exclude flies. It should be noted that the wire gauze, if broken even in one place, is useless, and requires immediate repair.

5. The floor, which is usually of earth, should be of stone, brick, or cement, hard, impermeable and smooth, and sloped sufficiently to run all water quickly off into a

drain, which must have sufficient fall to carry the water quickly away.

6. A sink must be provided, not on the floor, but well raised, so that the water from it can be caught in a movable receptacle outside. This receptacle must be above ground, and not placed in a catchpit dug in the soil, which quickly becomes foul and offensive, and can never be properly cleaned out.

7. A strong raised table should be provided for chopping meat, etc. An old iron target on brick supports answers admirably. Wood covered with zinc or tin does not do, as the metal soon cracks, and matter gets in and lodges underneath. The native custom of cutting up meat and performing all the operations of cookery upon the floor needs only to be mentioned to be condemned. Yet until recently everything in the cook-house was arranged to suit such practices.

8. A meat-safe, properly fitted with wire gauze or perforated zinc, is required, and should be hung up in the shade outside the cook-house. A wooden cupboard completes the furniture.

The cooking-places and the whole kitchen must be kept scrupulously clean, and no dirt or rubbish allowed to collect. Native cooks throw nothing away, and if permitted will fill the place with dirty tins, filthy rags, and broken bottles.

Unless the water-supply is quite pure, the kitchen floor should only be swept daily and washed weekly with a strong solution of Condy's Fluid. If the floor and walls are allowed to remain in a state of chronic dampness, they are likely to furnish an anchorage and breeding-ground for any germs which may be accidentally imported into the kitchen.

No latrine sweeper should be allowed on any account to approach the cook-house. A special sweeper with a special broom must be told off for kitchen work; he could also, if necessary, be utilized in the canteen and coffee-shop. This is an important point, as many outbreaks of disease have been traced to germs brought into the kitchens by sweepers, who have either gone there to work or to sit and chatter with their friends.

The native cooks in barrack kitchens are

either low-caste Indians or Goanese, and, as the work is heavy and the pay low, are usually poor specimens of their class, and intensely dirty in their habits and their cookery. Hence a soldier must be placed in charge of each cook-house to enforce cleanliness and to see that the cooking is properly conducted. No native clothing must be kept in the cook-house, or used to wipe the dishes with, or to wrap things up in. No unauthorized person must be allowed to enter the kitchen, otherwise it will always be filled with cooks, sweepers, and their families, and reek with the fumes of native tobacco.

The cooks should be medically inspected weekly, and should be provided with special clothing to wear while at their duties, their own clothes being left outside in the veranda and fully exposed to the sun. They should never be allowed to sleep in the kitchens, which they like to do, particularly in winter.

Every cistern and water-pot should be filled on Saturday night with weak Condy's solution, which should be left in till Sunday morning, and if the water-supply be doubtful

the same should be used daily to wash up plates and dishes.

Cooking-pots, or degshies, are made of copper, tinned inside with an amalgam, which should not, but usually does, contain lead. Much vigilance is required to get this process carried out, so as to avoid copper-poisoning on the one hand, and lead-poisoning on the other. Many unexplained cases of pseudo-cholera might be traced to this source. The iron 'Flanders kettles' in use among the troops are, by regulation, tinned regularly, just as if they were copper. It is much to be hoped that enamelled iron, steel, or block-tin utensils may some day take the place of the present archaic and unsatisfactory arrangements, but vested interests stand in the way. Steel cooking-pots are being taken into use in private bungalows with considerable success; although rather costly at the outset, the initial expense is soon recouped, as they do not require tinning.

Cloths or dusters, called jharans, are required for use in the cook-house. Till quite lately this fact was not recognised, and

the cooks had to use any old stuff they could find, generally dirty bits of their own worn-out clothing, for the purpose. Hankin traced an outbreak of cholera at Sangor to contact of food with dirty jharans, and doubtless many other cases have arisen in the same way. It is not only necessary to have these dish-cloths, but they must also be washed regularly and preserved from the risk of infection. For this purpose they should be issued to the cooks twice a week in sufficient numbers, and the dirty ones boiled in the kitchen and hung up to dry in the sun. This is a much safer procedure than handing them over to the dhobi.

The cook-houses belonging to the sergeants' mess, the temperance rooms, and the married quarters are particularly likely to be in an unsatisfactory condition, and to these must be added the kitchen of the officers' mess. Mess secretaries, as a rule, although animated with the best intentions, know little of practical sanitation, and mess sergeants know still less, so that the mess cook is left quite untrammelled to run his kitchen in his own

way. A crowd of native servants and hangers-on practically live on the premises under no supervision whatever; and there is no check on sweeper or bhisti.

The cook also, by his partiality for producing creams, blancmanges, and jellies, made with bazaar materials, provides, as Hankin has shown, what are practically 'nutrient media' for any pathogenic germs which may happen to be present.

These considerations go far to explain the heavy incidence of enteric fever amongst the officers.

The sergeants' mess kitchen is under the charge of the mess caterer, who is periodically changed, and is naturally not much interested in cook-house hygiene. It is, in consequence, apt to be in a dirty and neglected condition, with dirty cooking-pots, glass and crockery. The traditional arrangements of sergeants' messes have a tendency to foster drinking among the N.C.O.'s, as is shown by the greater amount of alcoholic disease among them as compared with the rank and file, although to get promotion, in the first

instance, a man must have a character for sobriety. Efforts should be made to discourage promiscuous drinking during the day, and to recommend a moderate amount of alcohol in the evenings.

The temperance-room kitchen is usually a more or less makeshift place, small, and deficient in equipment. The profits of the temperance institution must be considerable, and there seems to be a tendency to spend the money in other directions than on proper kitchen utensils and sound food and pure water, with the result that temperance in a soldier in India entails increased exposure to infectious disease, which obviously should not be the case. The married soldiers' cookhouse also usually suffers from lack of supervision. It is best to get one of the married sergeants put in permanent charge of it, explaining to him carefully the necessary precautions.

Major Rennie, R.A.M.C., has suggested bread as a vehicle for infection, the native flour being contaminated in kneading, and not heated enough in the baking to destroy

germs lodged in the centre of the dough. Hankin has also recorded a case. It is therefore highly desirable that all bread for the troops should be made in a commissariat bakery, under proper sanitary supervision. It would also be most advantageous if the cakes, pastry, and biscuits sold in the coffee-shop and temperance-room could also be made in the Government bakery, instead of, as at present, in some native bakehouse in the purlieus of the bazaar, whence they arrive heavy, sodden, and indigestible, and possibly also containing germs of disease in an active state.

CHAPTER VI.

MILK.

I. Milk forms a good pabulum for various pathogenic germs.

II. The cholera spirillum will live but a short time in milk, but enteric germs exist in it for considerable periods.

III. Many pathogenic germs which are common in milk in England seldom or never occur in it in India.

THE supply and storage of milk are matters of sufficient importance to call for separate consideration. Everything connected with native milk-dealers and milking arrangements is dirty in the extreme, and milk is a most excellent breeding-ground for all sorts of microbes. Milk epidemics are, notwithstanding, rarer in India than at home; women and children, who are the principal milk-

consumers, suffer far less from enteric and cholera than do the soldiers, who drink very little milk except when in hospital. This becomes intelligible when we remember that enteric fever does not prevail among the natives, and that the cholera microbe, which is common among them, will not live in milk when it has become in the least sour, which happens much more quickly in a hot than in a temperate climate, and in a dirty receptacle than a clean one. Tubercle, scarlet fever, and diphtheria, which are commonly milk-borne diseases at home, are fortunately very rare in India. Still, after all deductions, we must look on milk as a somewhat dangerous article of diet, not only as regards water-borne disease, but also as frequently causing infantile diarrhœa.

The official system in vogue in India is for each hospital and regiment to have its own separate dairy, in which the cows, employés, and utensils are provided by a native contractor, and more or less subject to European supervision. This is not a good arrangement. In the case of the hospital proper, buildings

may perhaps be available; but the quantity of milk required is liable to great and sudden fluctuations, so that the contractor ought to keep up a considerable reserve of cows, but naturally does not, preferring to eke out the amount required with surreptitious supplies from the bazaar.

The regiment, being constantly on the move, cannot afford to spend money on permanent buildings for its dairy. Government does not build regimental cow-houses or milk-stores, so a makeshift arrangement has to be improvised in some stray hut or old tent, while the milk is probably kept in the hut in which the milkmen and their families live. Better accommodation may exist in some stations, but if so it is quite exceptional.

The cows kept are the ordinary native breed, which give but little milk, and are always too few in number to meet the requirements of the dairy, which supplies officers and their families, and other residents in cantonments, as well as the troops. Milk and butter from the bazaar are there-

fore surreptitiously introduced into even the best regimental dairies, rendering them totally unreliable, and even dangerous.

The utensils in use are generally lotahs and degshies, very old and much battered, so that their dented surfaces set real cleanliness at defiance. It would be a great advance in Indian sanitation if in every cantonment a permanent station dairy were instituted under a permanent European superintendent. Such an establishment would have the proper plant and buildings, and a sufficient number of good cows, and would be carried on entirely in accordance with modern sanitary ideas. The minimum requirements for such an establishment would be: Accommodation for some hundred cows, with house for superintendent, huts for natives, good water-supply, dairies lined with glazed tiles, and good pasturage for the cows. Such dairies will certainly be instituted in the near future, and, if properly managed, should return a large profit to the Government. To effect this, however, proper organization and equipment is imperative. A bogus establishment starved for lack of

funds, subject only to a casual inspection of the Cantonment Magistrate or Civil Surgeon, would be worse than useless.

In the meantime, we have to consider the best treatment for the existing dairies. The Indian cow is usually undersized and ill-fed; its average yield is from five to six seers of milk only. They are never washed or groomed in any way, but are kept in a filthy condition, so that at the outset dirt and cow-dung find their way into the milk in considerable quantity. There is no real necessity for this, and with trouble the milkmen (gwalors) can be got to keep their animals comparatively clean. All the cows should be branded so as to be easily recognisable, and if any one of them fall sick, it must be at once isolated from the rest and the matter reported. The fodder should be looked at occasionally, and if the cows are pastured, the grazing-ground must be examined, and the animals strictly confined to it; otherwise, if allowed to stray, they will, in their search for salt, eat all sorts of excrementitious matter. Milk will not by such means become specifically con-

taminated, but filthy feeding must obviously produce unwholesome milk, causing diarrhœa and gastric disorders in children, if not in adults.

The milk people (who are Hindoos) with their families live among the cows, and also collect the cow-dung for fuel, plastering it in cakes on the walls of their huts to dry, the result being that the milk has to run the gauntlet of all possible dirt, human and animal, and the quantity that it takes up may be judged by inspection of the sediment at the bottom of the milk-pans.

Milk becomes the vehicle of cholera or enteric fever—

1. By being put into dirty utensils which contain infected water.

2. By adulteration with infected water or infected bazaar milk.

3. By contamination through the hands or clothes of the milk people.

To avoid these sources of infection it is necessary to see that—

1. The milk-people and cows are free from disease.

2. That the cows are groomed daily and properly fed.

3. That the milk people are reasonably clean in their clothing, and that they wash their hands and the cow's udders before milking, preferably with weak permanganate solution.

4. That the cowshed and all the dairy buildings are kept clean and frequently whitewashed, and that the cattle are not overcrowded.

5. That there is an abundant supply of good water, and that no latrine exists in the neighbourhood of the dairy.

6. All the utensils should be of glazed earthenware, tin, or galvanized iron, and kept perfectly clean and bright. They should be periodically washed in permanganate solution.

7. Stringent precautions must be taken to prevent anything whatever being added to the milk after it has been taken from the cow. In hospitals it is now a common custom for the cows to be brought down to the hospital building and milked on the spot

in the presence of an N.C.O. Otherwise it is a good plan to have the cows milked into cans which can be at once padlocked and carried off to their destination. In either case care is needed, or adulteration with water or bazaar milk is certain to occur. If a European soldier supervises the milk he must be frequently changed, otherwise repeated attempts to bribe him to overlook irregularities will be made.

The question of the storage of milk is important, as it readily absorbs pathogenic germs, and rapidly becomes tainted if exposed to any sewage emanation, the *Bacillus coli communis* growing luxuriantly in it. No milk, butter, or cream should therefore be kept in any hut or room inhabited by people, or in any place in which cow-dung is stored. The dairy should be a cool, clean place, and the milk put in vessels covered with gauze to guard against the infection-carrying flies. The door and windows must also be protected by wire gauze and 'chicks.' No sweeper must on any account ever enter the room.

Milk should never be allowed to stand

uncovered anywhere, but especially not by the bedsides of patients in hospital, where germs are certain to abound. Many of the cases of enteric fever which arise in the wards are probably caused in this way.

Owing to the difficulty of getting good cow's milk in India, infants are often reared on condensed milk, with excellent results. Care must be taken that the best unskimmed brands only are used for this purpose, as cases of rapid emaciation in infants may often be traced to their having been unknowingly fed on skimmed milk; the sale of skimmed brands should therefore be rigorously prohibited in the coffee-shop. Instructions must also be given for the proper dilution of the milk and the scrupulous cleansing of the feeding-bottles, otherwise infantile diarrhœa is certain to result.

It is difficult to see why a few goats should not be kept in every regimental dairy; they give most excellent milk, cost little, require very slight supervision, and are very clean feeders. In places where the milk-supply is doubtful, or cannot be efficiently

supervised, it can always be rendered perfectly safe by boiling or sterilizing. Both these processes, however, render milk less digestible and nutritious, and should therefore not be used as a routine practice where milk is intended for infants or children, but only resorted to in case of necessity. Scarlet fever, diphtheria, and consumption are all rare in India. Enteric fever and cholera are only occasionally conveyed by milk, and therefore boiling and sterilization are less likely to be required there than in England. The addition of boric acid or other chemicals to milk for preservative purposes is objectionable, as it renders it unwholesome and indigestible—at any rate, if its use is persisted in—and is specially undesirable in milk which is to be taken by children.

CHAPTER VII.

BARRACKS.

I. Disease may be imported from the bazaar into the barracks by the natives employed there.

II. Disease may also be disseminated by the washing arrangements in vogue in India.

III. Any overcrowding or lack of ventilation facilitates the spread of disease.

As has been before stated, the choice of sites for barracks in India is usually dictated by strategic or economical considerations without special reference to hygiene.

The majority of Indian barracks are large, airy, and spacious. Wherever this is not the case, and there is any tendency to overcrowding (as in some frontier and hill stations), there is a rapid decline in the health of the troops, with an immediate increase in the

number of fever cases, and in winter of lung affections and infective pneumonia. The prevalence of the latter disease among the native troops is probably largely due to the ill-constructed huts they inhabit.

It is a point of great importance that, besides the sweepers, cooks, and bhistis, all dhobis, gwalors, syces, lascars, punkah-coolies, etc., should be paraded regularly for medical inspection, and that at the same time their families should be seen by a hospital assistant, so that any diseased person may be picked out and sent to hospital. During the hot weather, a large number of natives are taken on to work the punkahs and tatties. These are all of the lowest coolie caste, and liable both to bring disease into the lines and to foul the surface of the ground. All cook-houses or other buildings not in use must be kept rigorously locked up, otherwise they are certain to be used by natives for latrine purposes, and may thus give rise to an unexpected outbreak of cholera when subsequently taken into use.

The objections to permitting the sweepers

to enter the barrack-rooms have been already dealt with, and in general terms it may be safely asserted that the more the soldiers do for themselves, and the fewer the natives employed in the lines, the less likelihood is there of an outbreak of infectious disease.

Barrack-rooms are usually kept clean enough, and are whitewashed at stated intervals. The men usually have their meals in the veranda or special dining-rooms, and are so far better off than their comrades at home, who sleep, eat, and live in the same apartment. The system which sometimes obtains of placing an extra row of beds down the centre of the barrack-room is most insanitary, as it renders proper ventilation impossible.

In hill stations men should not be allowed to sleep out in the verandas, as chills, due to the fall of temperature which occurs towards morning, are a fruitful source of ague. In the winter, care must be taken that windows and ventilators be not blocked up by the men to secure warmth, thereby vitiating the atmosphere.

In all places that are at all malarious, the

men's sleeping-rooms should be, if possible, on the upper floor, or, if that cannot be, they should be well raised above the soil on a terrace, and floored with stone or some impermeable substance. Neglect of this precaution commonly causes ague.

The insanitary nature of the washing arrangements in India may be realized when we say that scabies is universally known as 'dhobis' itch,' and is far from uncommon in all grades of society. The Indian washerman will wash clothes with the greatest *sang-froid* in any stagnant pool or dirty tank which is conveniently near his place of abode, and will continue using the same dirty water indefinitely, until it swarms with microbes, enteric or otherwise. Even when a river is available, the wet linen may be infected by being spread out to dry on ground already contaminated by the natives. Dish-cloths have thus carried infection into the cook-houses with disastrous results, as recently occurred at Jubbulpur.

The following precautions are therefore, at any rate, necessary:

1. The site of the dhobi ghaut, or washing-place, should be inspected and approved, and no other place allowed to be used.

2. If there is no suitable place with a sufficient supply of running water for the purpose, the dhobis should be made to use tubs or buckets, and to do their washing within, or close to, the lines. These tubs must be daily emptied and cleaned, and periodically washed out with permanganate of potash solution.

3. Soldiers' washing should be done separately from that of either civilians or natives.

4. The hospital soiled linen should be treated quite by itself, and most anxious pains should be taken that not only the sheets, but also the blankets, and everything which has come in contact with any infectious case, should be thoroughly disinfected with antiseptic solution before being given to the dhobi.

5. It is necessary that both the dhobis and their families should be subject to medical inspection.

6. It is safest for all jharans and kitchen-

cloths to be boiled and washed in the cook-house, and not given to the dhobi at all.

The soldiers' recreation-rooms are usually well provided with papers, games, and books, and are much frequented by the men. This is important, because in India soldiers have much spare time on their hands, and this, together with the climate, often causes tedium, ennui, home-sickness, intemperance, and even suicide. Towards the end of the hot weather, everyone grows more or less irritable, and small grievances loom large, and there is a universal feeling of lassitude and inertia. Recreation and occupation are therefore very necessary for the men. Much progress has been made in this direction of late years, as, in addition to the recreation-rooms, soldiers have been encouraged to take up gardening, and to learn various handicrafts, besides the usual games and theatricals, with the result that there has been a marked diminution both in crime and sickness.

The regimental temperance-room, where teas and suppers are served, requires very careful supervision. Mineral waters made

in the bazaar, noxious cakes and pastry from the same source, dubious dishes composed of mysterious tit-bits, bazaar-made sausages, bazaar milk, and the like, all find their way into these places. The cups, plates, and knives are washed by a perfunctory dip into a basin of very dirty water, followed by a wipe with an equally dirty cloth, and there is usually no attempt whatever to provide pure water for drinking. This state of things ought not to exist for a moment; but besides careful supervision, it is necessary that money should be forthcoming to provide proper equipment for these places, in order to keep them in a satisfactory state.

The guard-room and its dependencies require special notice, as, owing to the lack of continuous responsibility, its water-supply and sanitary arrangements are particularly liable to get out of order. As the hot weather comes on, recommendations for reduction or relaxation of the guard duties may be required. It should also be ascertained that the men on guard get coffee or cocoa served to them in the early morning

as a precaution against fever. The temperature and ventilation of the cells and prisoners' rooms must be specially looked to in the hot weather, and it should be remembered that military prisoners in India are far more liable to sudden illness or suicidal impulse than at home, and solitary confinement is decidedly more trying.

With regard to the canteen, or liquor bar, as it is now officially termed, we should remember that Hankin found the enteric bacillus in a sample of canteen beer, evidently the result of adulteration with infected water. There is a marked tendency nowadays to make the liquor bar as unattractive as possible, in the hope that the men will resort to the reading and recreation rooms in preference. This policy is a short-sighted one, as, if the soldiers are uncomfortable in their canteen, they go off to the bazaar, and drink bad liquor and spirits, which are vastly more injurious than beer.

Although temperance has made great strides in the army, a good deal of disease which is put down to climate would be more

correctly attributed to alcohol, particularly hepatic and renal disorders, from which the soldier is very apt to suffer, owing to his habit of drinking a quantity of beer in the middle of the day, and sleeping heavily after it. This habit also predisposes in a high degree to sunstroke and heat apoplexy. It would be very desirable to limit the sale of beer in the canteen until after sunset in the hot weather, but such a measure would be scarcely possible.

The swimming bath is much patronized by the men in the hot weather, although excessive indulgence in bathing is apt to cause a severe attack of prickly heat. It is always possible for the bath-water to become infected by disease germs, and such an occurrence has now been demonstrated to have taken place on several occasions. It would therefore be advisable, if cases of enteric or cholera are about, to run the water off and cleanse the bath with strong permanganate solution. It is always necessary to see that the water be frequently changed, otherwise it may remain untouched for considerable periods.

A word may be said here on the care of the surface of the ground in the lines. Rubbish and stable litter should, of course, never be allowed to accumulate; neither should waste water be thrown out on the ground, for it tends to produce ague. For the same reason, gardens and grass-plots, which require heavy watering, should always be kept at some distance from the lines. Trees should not be so close to buildings as to prevent the free circulation of air. If there is no proper surface drainage, the waste water from barracks and washhouses must be run off into plots of ground well broken up and planted with willows.

Soldiers in India keep numerous pet dogs, but unfortunately, owing to the presence of pariah dogs and jackals, hydrophobia is comparatively common, several cases occurring annually among the troops. The number of dogs kept should therefore be limited, and the men should be instructed to isolate and report any animal showing symptoms of disease. Occasional veterinary inspection would be a good thing, if possible. Dogs

should be rigidly excluded from the neighbourhood of the cook-houses, to prevent the possibility of their originating hydatid disease.

Finally a word may be added on the men's washhouses or lavatories. They are constructed on the same lines as those at home, and have the same defect, viz., that no arrangement whatever is made by which the men can ever obtain any hot water for purposes of ablution. This is naturally less felt in India than in England; still, at any rate, in the cold weather it militates greatly against real cleanliness. If more modern washing arrangements and greater privacy could be secured to the men, we might expect a diminution in the amount of venereal disease, which is so undoubtedly fostered by dirt and by the difficulties men experience in washing themselves. An ablution arrangement could easily and at small cost be attached to every urinal in the barracks, and the men would certainly avail themselves of the convenience.

CHAPTER VIII.

BAZAARS.

THE bazaars, or collections of native shops and houses, play an important part in the soldier's life in India. They are of two kinds—large bazaars for native towns, and the smaller sudder bazaars, which have grown up in the immediate neighbourhood of the barracks, and specially cater for the soldiers' wants. The sudder bazaar comes under the control of the Cantonment Magistrate and the Civil Surgeon, and unless it is kept in good sanitary order, much of the labour of the medical officer in charge of troops is thrown away, for it is undoubtedly the case that when barrack sanitation is complete, the soldier will contrive to con-

tract enteric or cholera in the bazaars. This fact furnishes a strong argument for collecting all the bazaar women into one particular locality, where they could be properly housed and their surroundings made hygienic. A great deal of good might also be done, and much sickness and invaliding prevented among the troops, if drastic police measures were taken to prevent disreputable persons from haunting the immediate neighbourhood of the lines. These simple precautions, together with increased facilities for cleanliness (the present washing arrangements for soldiers are in many ways inadequate), would probably notably diminish the amount of contagious disease in the cantonment.

The soldier is tempted at every turn by the numerous liquor shops in the bazaar, which retail the cheap and poisonous 'country liquor,' or arrack. They are a source of much harm both to soldier and native, and benefit only the revenue. Their number ought to be largely reduced.

In the event of an outbreak of plague or other infectious disease in the bazaars, the

whole native quarters must be rigidly put out of bounds, not only for the troops, but also for all regimental followers. In the case of plague, special measures should be taken in addition, to procure food for the latter from some uninfected district, as the disease seems particularly likely to be carried by grains of all kinds.

In the event of European troops being employed on 'plague duty,' certain precautions are desirable. Only perfectly healthy men should be so employed, and any man sustaining a cut or abrasion removed from the duty. They should be isolated from the rest of the regiment, and on returning from work should have a thorough wash and change of clothing. They ought to have a substantial meal before starting and on returning from plague duty, but should eat nothing while at work.

The question of the prophylactic inoculation of troops will have to be considered by the Medical Officer in the near future; at present the matter is in the experimental stage. Haffkine has obtained excellent

results by his inoculations against cholera among the Assam coolies, so that we may expect anti-cholera vaccination to become general. Professor Wright at Netley has prepared an anti-typhoid serum, which was used during the enteric outbreak at Maidstone, but the results have not yet been made public. Various plague serums have recently been used among the natives in Bombay. Of these, Haffkine's has yielded results which are at any rate promising, while Yersin's seems to have been a complete failure.

It is very desirable that the Medical Officer should, as a matter of routine, occasionally walk through the bazaars, and look into the articles of food and drink there supplied, and also notice that proper cleanliness and conservancy are duly enforced. Such visits, to be useful, should be made quite casually, and he will probably find the authorities glad to carry out any suggestion he may have occasion to make, and to remedy the defects he may observe. The natural tendency of the native is to crowd house on house, leaving

the narrowest passages only for streets, and no open spaces whatever. The results of this system may be seen in the recent outbreaks of plague in Hong Kong, and Bombay and other Indian cities.

CHAPTER IX.

THE SOLDIER.

I. Malaria in all its forms is due to the presence of a parasite in the blood (Plasmodium).

II. Its life-history is not at present worked out; hence the great difficulty in combating the disease. Its occurrence in man is closely related to chill, damp, and deficient drainage of the soil.

III. It is specially prevalent in certain places and at certain times—usually when the 'ground-water' is at its highest level.

IV. A first attack predisposes to subsequent attacks, and some people are much more susceptible to the malarial poison than others.

HAVING in the previous chapters examined the various sections of the barracks, we now come to consider the soldier himself in relation to his clothing, equipment, and work. The subjects here dealt with relate

more to malaria than to enteric fever or cholera, with which we have so far been chiefly concerned. It will be better to speak rather of the diminution than the prevention of malaria, as prevention, in the present state of our knowledge, can only be arrived at by sanitary works far beyond the province of the Medical Officer in charge of troops. The underlying principle of all such endeavours must be the removal of stagnant water from the surface, and the prevention of any water-logging of the soil beneath, together with the selection of elevated and healthy sites for barracks. To attain these results, elaborate irrigation schemes are necessary where waste lands have to be reclaimed, as at Quetta. In other places over-irrigation has to be checked, as at Jubbulpore. Elsewhere, as at Delhi, the river requires to be embanked, so that the main stream may flow beneath the city walls, and no mass of malodorous mud be left to poison the air after the rains. In other places, proper subsoil drainage and judicious tree-planting may suffice.

The discovery of the presence of a parasite

in the blood of ague cases, and the work of Laveran, Manson, and others, have given a great impetus to the study of malaria in all its forms. Yet, although the *materies morbi* has been discovered in the blood corpuscles in the shape of the *Plasmodium malariæ*, its life-history outside the body is still unknown, and it is therefore impossible to speak dogmatically as to the best means of defence against it.

The disease is also common in animals, especially in birds, and there is considerable evidence in favour of the theory that the parasite is communicated to water by the drowning of the females of certain species of mosquito, who have previously filled themselves with the blood of persons or animals suffering from ague. Mosquitoes, it may be added, repair to the water to lay their eggs. Personal experience, however, points in another direction, and in practice we find the disease caused by exposure to mists and damp, to chills, to sleeping on the ground, and to undue exposure to the sun. It is on these lines that the disease must be fought.

The evidence of malaria arising from drinking water is very slight, all the instances quoted in support of the theory being old and inconclusive, while no new examples are adduced.

The actual death-roll from malaria is not great, but the indirect mortality is considerable, the amount of sickness and invaliding enormous. It also strikes at the root of military efficiency, for a malaria-stricken regiment is totally unfit to take the field, the men breaking down completely after a few days' campaign. It predisposes to enteric fever, and the typho-malarial fever of the older writers may be defined as enteric, occurring in a patient already suffering from malarial cachexia. Attacks of ague are also common during the course of enteric fever, the diagnosis being often obscured for a few days in consequence. Malaria has a specially pernicious effect on venereal disease. In ague-stricken men who have acquired syphilis, sores ulcerate and refuse to heal, there is great prostration, and all the symptoms, primary, secondary, and tertiary, are much enhanced in severity, and rendered less

amenable to treatment. It is to syphilis occurring in malarial cases, and not to any special severity of the disease, that we owe the terrible cases of syphilis so often invalided home from India.

Besides the ordinary forms of ague, there is an intensely acute disease, fortunately rare, known as pernicious malarial fever, which destroys life in a few hours. Such cases have been usually returned as heat apoplexy, though certainly malarial in their nature. Dr. Sambon has lately published in the *British Medical Journal* an elaborate paper to show that most cases of sunstroke and heat apoplexy are really cases of an acute specific fever. Much further investigation will be required before these views can be accepted.

Evidence of the existence in India of Mediterranean or Malta fever is steadily accumulating. This disease, which in its symptoms resembles ague, is really akin to enteric fever, and has a specific bacillus (*Micrococcus Melitensis*). The progress of this disease is totally unaffected by quinine, and its hitherto

unnoted presence accounts for the discrepancies in the observations recorded as to the value of quinine both in the treatment of fever and as a prophylactic. It accounts, too, for the cases of apparent ague one meets with frequently in practice, which run a prolonged course without marked periodicity, without typhoid symptoms, and without any reduction of temperature by large doses of quinine.

Clothing is a most important factor in the prevention of ague. In the hottest weather the soldier wears white clothes, otherwise he has khaki, and in the cold weather serge or cloth uniform. He always has a flannel shirt and cholera-belt next to the skin. If his clothing is too light, he will get a chill, and probably fever; if too heavy, he will sweat profusely, and thus also get a chill, and very likely an attack of prickly heat. Great care is required at stations in Northern India and the Punjaub, where the diurnal variations of temperature are often extreme, to ensure the men being properly clothed. In these circumstances cloth and serge

clothing should be adhered to as long as possible, in preference to the convenient but treacherous khaki. In severe cold wadded coats and poshteens are required.

In every station the dates of changes of clothing for the troops should be settled according to local exigencies, instead of depending on some central authority, possibly hundreds of miles away, who is probably entirely guided by precedent, and not by the thermometer.

Khaki is the clothing most worn by the soldier in India. Although very strong and serviceable, it has no heat-retaining or damp-resisting powers whatever. It should, therefore, never be worn in cold weather, as is often done on account of its convenience. All Indian uniforms should be much looser than they are, too much being still sacrificed to so-called smartness.

The present regulation helmet is unsatisfactory, being too heavy, affording no protection to the eyes, and if made long enough behind to protect the nape of the neck it falls over the man's eyes when he lies down to

shoot. A quilted curtain at the back has sometimes been used on service, but it is very heating to the neck. Something in the style of the ordinary civilian topee or shikar hat, with a good broad brim, would be a much more practical head-covering. There is always trouble in getting soldiers, particularly the new arrivals, to wear their helmets, and not to expose their heads recklessly to the sun. In the mornings they will stand about barracks bareheaded, and early in the afternoons escape to the bazaar, wearing the smallest possible caps. Wadded spine-protectors sewn in the coat are a necessity for any troops who, on service or otherwise, are likely to be exposed to the full heat of the sun, and are always worn by officers when pig-sticking.

Putties replace the leathern leggings worn in England, and are far more comfortable, as they do not press upon and blister the heels. They are, however, heating to the leg, and perhaps to some extent impede the circulation. A light gaiter is therefore recommended instead by some authorities.

A cholera-belt is issued to every soldier, and is certainly necessary in the hot weather, when the men lie stripped beneath the punkahs, and the draught rapidly evaporates the perspiration and chills the abdomen, so that if the belt is not worn, a smart attack of diarrhœa is certain to follow.

The regulation boot, if a proper size is worn, and if not made too heavy by extra nails, is an excellent one. When sore feet occur, it is more often due to a badly-mended sock than to the boot. It would be better for the men to grease, and not black, their marching-boots, as blacking makes them stiff and hard, and also hotter to the feet. The German system of substituting a greased rag for the sock is to be commended.

In general terms, the more exercise a man can take in India, the more likely he is to keep his health. The soldiers' exercises are, of course, governed by military considerations, but there are certain hygienic precautions which should be carried out in connection with drills and parades. In the first place, neither officers nor men should go

on early morning parade in hot or cold weather without having something to eat. A cup of cocoa or coffee with a biscuit is sufficient, but without something of the kind, liability to chills and fever is greatly increased. Theoretically this point is generally acknowledged, but in practice the subaltern 'has not time,' and the private too often finds his coffee and biscuit too unpalatable, so that, as a matter of fact, the majority of men do go on parade with empty stomachs.

In the cold weather parades are often ordered much too early, so that men get thoroughly chilled before starting, and fever results. Occasional evening parades and night marches have been recently instituted during the hot-weather months, with excellent effect, the men getting moderate exercise, together with some variety in the monotony of their existence. In the hot weather it is most desirable to keep the men employed, at any rate up to 10 a.m., so as to somewhat shorten the day for them. This might be done by means of lectures and instruction under cover, when it becomes too hot for outdoor parades.

Men going through their course of musketry are likely to be kept out too late in the morning, and to suffer from sun-exposure in consequence, aggravated by the glare which is inseparable from a rifle-range in India. It is important to ascertain that a proper supply of drinking-water is provided on the range, both for the men shooting and for the markers; otherwise they drink any dirty water obtainable, with bad results. This is a point which is very generally overlooked.

Cricket and football are, of course, to be encouraged in every way, particularly the latter, as it gives most exercise to each individual, and avoids the exposure to the sun entailed by a whole-day cricket-match. A recreation-ground should be provided some little distance from the lines, so as to get the men away from their barracks. Arrangements should be made for the sale of light refreshments on the ground, otherwise it will be found that the men will prefer an extemporized game adjacent to their canteen.

The health of the soldier in India would

be much improved if he could be induced to take his principal meal after sunset instead of at mid-day. As it is, a heavy meat dinner is eaten at 1 p.m., the very hottest time in the whole twenty-four hours, washed down with a copious libation of beer, after which the men swelter on their beds in uneasy slumbers until five or six o'clock in the evening. It is difficult to imagine any procedure more likely to produce hepatitis and every form of headache and dyspepsia. Unfortunately, tradition and custom are likely to be too strong to admit of reform in this direction.

The natives of all hot countries invariably sleep in the middle of the day, and much controversy has raged round the question as to whether the same habit should be adopted by Europeans. The truth appears to be that a siesta directly after a heavy luncheon or dinner certainly causes headache, a furred tongue, and general malaise. If, however, only a light meal is partaken of at, or before, noon, an hour or two's sleep will be productive of nothing but good. The Anglo-

Indian goes late to bed on account of the heat, and rises very early to get his work done before the coolness of the morning is entirely gone, so that he will fail to get his proper allowance of sleep if he takes no rest in the afternoon. A good deal of the excessive irritability, nervous exhaustion, and overstrain one meets with in India may fairly be attributed to insufficient sleep. During the cold weather sleep, meals, and exercise may be approximated to English hours.

During and after the rains in any place which is at all malarious, a daily quinine ration should be issued as a prophylactic; arsenic is much less effective. Some men are much more susceptible than others to malaria. Any who have had two or three attacks of ague in succession should, if possible, be sent out of the station for a time, to give them an opportunity of becoming convalescent, otherwise they will rapidly be reduced by recurrent attacks, and have to be invalided for malaria cachexia.

It is desirable that troops returning from the hills, and all troops arriving from other

stations, should be encamped well outside the cantonment for a week or ten days before taking over the lines or barracks, so that all cases of infectious disease may be removed to hospital, and not brought into the lines. A regiment should be quarantined for a month if it has recently had cases of enteric fever. By such action enteric fever may gradually be stamped out. For the same reason convalescents from enteric fever should be detained in hospital for some weeks, until they have completely regained their strength and there is no likelihood of the bacilli occurring in their stools.

Troops suffering from malaria, on the other hand, should never be left out in tents, as the exposure to the sun that this entails aggravates the disease. They should be brought into permanent barracks as soon as possible, and relieved of guard-mounting and all arduous parades. Such troops should, whenever possible, be left to recuperate in an equable climate, the sudden alternations of heat and cold of most hill stations tending to aggravate ague.

CHAPTER X.

FIELD SERVICE.

THE sanitation of British troops on active service in India has been admirably dealt with by Surgeon-Colonel Duncan, of the I.M.S., in his book on Tropical Campaigns, and only a few words need be said here on the subject. Sanitation on active service is simply the application of the same principles which govern barrack hygiene to particular circumstances as far as military exigencies will permit. Troops can endure great hardships, and yet keep their health, if they get pure water, fresh air, enough food, and clean camps, while overcrowding, dirt, infected water, or malarial camping-grounds, will soon render inefficient troops which have not even been under fire.

Careful planning of camps and arrangement of the watering-places is essential, especially if the ground is to be occupied for some time. Such matters should not be relegated entirely to the Quartermasters, as is too often the case. The conservancy of the ground must be attended to most strictly, and all latrine arrangements rigorously supervised. Water, if at all suspicious, should be boiled, and the men should carry cold tea (made weak, without sugar or milk) in their water-bottles. Beer and spirits should on no account be allowed during the march. At the end of the day a moderate amount of alcohol does no harm, but it seriously impairs a man's powers of endurance if taken during muscular exertion, and also renders men less capable of resisting the sun.

The most anxious care should be taken when sick convoys are sent down to the base to prevent any infection of the camping-grounds by enteric cases, otherwise troops returning later by the same route will be certain to acquire the disease in a virulent form, because their vital powers will have

been diminished by the hardships they have been through.

If troops have to march or camp in a really malarious district, special precautions must be taken. Great care must be given to the commissariat arrangements, so as to ensure to every man a good meal morning and evening under all circumstances. Thicker clothing must be taken into wear at sunset, and every effort made to avoid chills. In such camps the ground should not be broken up for any purpose whatever. Large fires of green wood should be lighted at night to drive off mosquitoes or other insects, and as a precautionary measure the water had better be boiled. The treatment of the men's water-bottles with permanganate of potash has already been described, and a daily ration of quinine should be issued to everybody. Among the natives opium is certainly a prophylactic against fever, and, given to Europeans, it will often abort a commencing attack of ague. A rum ration may with advantage be issued in the evening, otherwise alcohol should be altogether prohibited,

and replaced by tea, coffee, and cocoa. Tents are very apt to be grossly overcrowded, the numbers laid down in the regulations being in excess of what the hygienist would allow, and the hot foul atmosphere thus engendered in them at night predisposes men greatly to fever. Head-shelter against rain and sun is what is really wanted in a tent, with, in cold weather, a curtain on one side only, to keep off the wind. It is impossible to keep either the 'Lascar Pal' or 'E. P.' tent (the patterns at present in use) cool or properly ventilated, and the atmosphere in consequence, when the tent is closed and full of men, becomes foul in the extreme.

A waterproof material which shall remain porous, and off which the rain will run without soaking in, is still a desideratum.

THE END.

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